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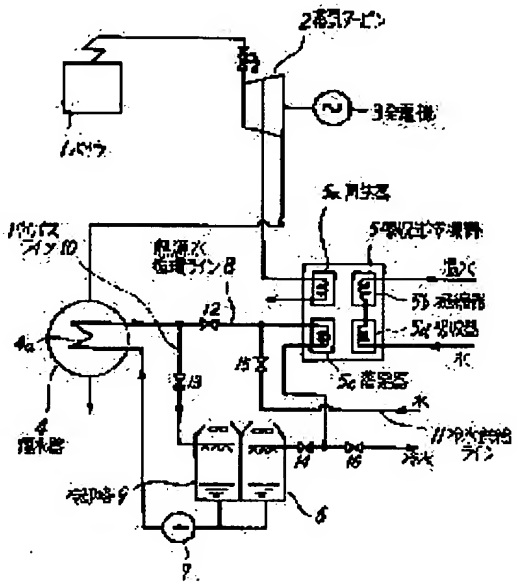
(54) EXHAUST HEAT RECOVERY SYSTEM FOR STEAM TURBINE EQUIPMENT

(57)Abstract:
PURPOSE: To provide an exhaust heat recovery system which utilizes exhaust heat of a steam turbine condenser to obtain hot water for heating and which is able to cope with variation of a heating load.
CONSTITUTION: Cooling water drainage from a condenser 4 of a steam turbine 2 is utilized as heat source water, which is fed to an evaporator 5c through a heat source water circulation line 8 arranged between the condenser 4 and the evaporator 5c of a refrigerator 5, and the refrigerator 5 is operated as a heat pump so as to obtain hot water for heating from a condenser 5b. In relation to the heat source water circulation line 8, a bypass line 10 is provided for returning a part of the heat source water from midway of the circulation line 8 via a cooling tower 9 to the condenser 4, and a ratio of feeding quantity of the heat source water to the evaporator 5c to a feeding quantity thereof separated to the bypass line 10 is adjusted in compliance with variation of a heating load.



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CLAIMS

[Claim(s)]

[Claim 1] It is the exhaust-heat-recovery system of the steam turbine facility which obtains the warm water for heating using exhaust heat of a steam turbine condenser. In what lets water flow to the evaporator of a refrigerator by using as heat source water cooling wastewater which came out of the surface condenser, operates this refrigerator as heat pump, and obtains the warm water for heating from a condenser As opposed to heat-source water cycle Rhine which piped between the condenser and the evaporator of a refrigerator It has the bypass line which returns some heat source water to a condenser via a cooling tower from the middle of a circulation line. The exhaust-heat-recovery system of the steam turbine facility characterized by operating by adjusting a rate with the amount of water flow which carries out splitting to the amount of water flow and bypass line of the heat source water poured to said evaporator corresponding to fluctuation of a space heating load.

[Claim 2] The exhaust-heat-recovery system of the steam turbine facility characterized by being the absorption refrigerator which a refrigerator supplies the steam extracted from the steam turbine to a regenerator, and is operated in an exhaust-heat-recovery system according to claim 1.

[Claim 3] The exhaust-heat-recovery system of the steam turbine facility characterized by obtaining the cold water for air conditioning from an evaporator through a cold-water supply line after connecting the cold-water supply line other than heat-source water cycle Rhine which piped between condensers to the evaporator of a refrigerator in the exhaust-heat-recovery system according to claim 1 and separating heat-source water cycle Rhine from an evaporator at the time of air conditioning operation.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the exhaust-heat-recovery system of the steam turbine facility applied as a cogeneration system of steam power generation.
[0002]
[Description of the Prior Art] In these days, a steam is generated by the boiler attached to a refuse incinerator as a method of using the heat energy for a city incinerator plant etc. effectively, the cogeneration system which was made to perform steam power generation and community central heating and air conditioning using this steam has been spread-ized, an absorption refrigerator is operated by making into a heat source the steam extracted from the steam turbine which drives a generator as that example, and the cogeneration system which obtains the cold water for air conditioning is known.
[0003] On the other hand, a refrigerator from heat pump operation which incorporates the heat other than frozen operation from an evaporator, and obtained the warm water for heating from the condenser side being possible While letting water flow to the evaporator of a refrigerator for the steam turbine facility especially described above by using as heat source water hot cooling wastewater which came out of the condenser of a steam turbine and obtaining the warm water for heating from a condenser side The exhaust-heat-recovery system by the heat pump which uses as cooling water the water with which conduction of the evaporator was carried out to coincidence, and temperature fell, and returned it to the condenser again is advocated, and the development is furthered.
[0004]
[Problem(s) to be Solved by the Invention] By the way, exhaust heat of a steam

turbine condenser is used as mentioned above, and the heating value which the evaporator of a refrigerator incorporates from a condenser is decided by the load of a condenser, i.e., the service condition of a steam turbine, by the exhaust-heat-recovery system which carries out heat pump operation of the refrigerator, and obtained the warm water for heating. For this reason, the whole quantity of the cooling wastewater which came out from the condenser cannot be made to correspond well like district heating in having carried out conduction to the evaporator of a refrigerator as it was when fluctuation of a space heating load is large.

[0005] This invention is made in view of the above-mentioned point, and it aims at offering the exhaust-heat-recovery system which enabled it to fully correspond also to fluctuation of the load of a condenser, and a space heating load by improving the exhaust-heat-recovery system of the steam turbine facility described the point.

[0006]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it sets to the exhaust-heat-recovery system of this invention. As opposed to heat-source hydrologic cycle Rhine which piped between the condenser and the evaporator of a refrigerator It shall constitute so that it may have the bypass line which returns some heat source water to a condenser via a cooling tower from the middle of a circulation line and may operate by adjusting a rate with the amount of water flow which carries out splitting to the amount of water flow and bypass line of the heat source water poured to said evaporator corresponding to fluctuation of a space heating load.

[0007] The absorption refrigerator which supplies the steam extracted from the steam turbine to a regenerator as a refrigerator in the aforementioned configuration, and is operated here is employable. Moreover, in order to obtain the cold water for air conditioning from a refrigerator in a summer using the exhaust air heat recovery system concerned, the cold-water supply line other than heat-source water cycle Rhine which piped between condensers to the evaporator of a refrigerator is connected, and after separating heat-source water cycle Rhine from an evaporator, the cold water for air conditioning can also be obtained from an evaporator through a cold-water supply line.

[0008]

[Function] In the above-mentioned configuration, a cooling tower cools the cooling wastewater of a condenser which carries out splitting to a bypass line from the middle of heat-source water cycle Rhine, lowers temperature, and it commits it so that it may return to a condenser again through a circulating pump. And when a space

heating load is changed at the time of heat pump operation, by adjusting the rate of the amount of water flow of the cooling wastewater supplied to the evaporator of a refrigerator as heat source water from a condenser, and the amount of water flow made to shunt to said bypass line, the heating value incorporated to the evaporator of a refrigerator is made to correspond to fluctuation of a space heating load, and can be adjusted proper.

[0009] Moreover, a refrigerator can be operated by adopting an absorption refrigerator as a refrigerator using the steam extracted from the steam turbine, without using a compressor. Furthermore, if frozen operation of the refrigerator is carried out where heat-source water cycle Rhine is separated from an evaporator, the cold water for air conditioning will be obtained through the cold-water supply line linked to an evaporator.

[0010]

[Example] Drawing 1 shows the schematic diagram of this invention example. In drawing, the boiler which installed 1 in the incinerator of an incinerator plant etc., the steam turbine which operates 2 with the generating steam of a boiler 1, the generator which connected 3 with the steam turbine 2, the surface type condenser of the steam turbine 2 with which 4 built in cooling coil 4a, and 5 are absorption refrigerators. Here, the absorption refrigerator 5 is equipped with regenerator 5a, condenser 5b, evaporator 5c, and 5d of absorbers, by making into a heat source the steam extracted from the steam turbine 2, is supplied to regenerator 5a and operated. In addition, about the refrigerating cycle of this absorption refrigerator, it is common knowledge, and the explanation is omitted here.

[0011] On the other hand, between cooling coil 4a of a condenser 4, and evaporator 5c of said refrigerator Heat-source water cycle Rhine 8 which returns from cooling coil 4a to cooling coil 4a again via evaporator 5c, a cooling tower 6, and a circulating pump 7 is piped. When operating a refrigerator 5 as heat pump, he lets water flow to evaporator 5c of a refrigerator 5 by using as heat source water hot cooling wastewater which came out of cooling coil 4a of a condenser 4, and is trying to obtain the warm water for heating through 5d of absorbers, and condenser 5b. Moreover, to aforementioned heat-source water cycle Rhine 8, it has the bypass line 10 which branches from the middle of Rhine and goes via a cooling tower 9, and the connecting piping of the cold-water supply line 11 which obtains the cold water for air conditioning other than above mentioned heat-source water cycle Rhine 8 is further carried out to evaporator 5c. In addition, 12-16 are the closing motion bulbs linked to every place of said Rhine.

[0012] In obtaining the warm water for heating with this configuration in winter, it is in the condition which made bulbs 12 and 14 open and made bulbs 13, 15, and 16 close fundamentally, and it lets water flow to evaporator 5c of a refrigerator 5 by using as heat source water hot cooling wastewater which came out from cooling coil 4a of a condenser 4, and gives the exhaust heat collected with the condenser 4 to evaporator 5c. Thereby, a refrigerator 5 operates as heat pump and the warm water for heating is obtained through condenser 5b and 5d of absorbers. In addition, since it is higher than the circulating water temperature demanded with a condenser a little, it lets pass and cools to a cooling tower 6, and cooling wastewater flows back to cooling coil 4a of a condenser 4 through a circulating pump 7 again, although water temperature falls since heat is taken in the process which carries out conduction of the evaporator 5c.
[0013] When a space heating load is small, the bulb 13 linked to a bypass line 10 is opened, and whenever [valve-opening] is adjusted, and some cooling wastewater is made to shunt toward a bypass line 10 from the middle of a circulation line 8 here. The amount of water of the heat source water which carries out conduction of the evaporator 5c of a refrigerator 5 by this, therefore the heating value which evaporator 5c incorporates come to correspond to the space heating load at the time. In addition, after being cooled in a cooling tower 9, the cooling wastewater shunted toward the bypass line 10 joins the water which went via evaporator 5c and a cooling tower 6, and returns to a condenser side again. Thus, by adjusting the rate of the amount of water flow of the heat source water poured to evaporator 5c, and the amount of water flow made to shunt toward a bypass line 10, it can be made to be able to respond to fluctuation of a space heating load thru/or the load effect of a condenser, and the thermal output of heat pump can be adjusted.
[0014] On the other hand, in obtaining the cold water for air conditioning in a summer, while closing bulbs 12 and 14 and separating heat-source water cycle Rhine 8 from evaporator 5c, a refrigerator 5 is operated for cooling water in the state of [this] a sink to the cold-water supply line 11 which opened bulbs 15 and 16 and was connected to evaporator 5c. The water which flows to the cold-water supply line 11 is cooled by evaporator 5c by this, and the cold water for air conditioning is obtained.
[0015] In addition, although the illustration example described the example which adopted the absorption refrigerator as a refrigerator, even if it adopts a compression refrigerating machine instead of an absorption refrigerator, it can carry out similarly.
[0016]
[Effect of the Invention] As stated above, according to the exhaust-heat-recovery system of the steam turbine facility by this invention, the warm water for heating

required for district heating is obtained by operating a refrigerator as heat pump using the exhaust heat which collected from the condenser by having had the bypass line which returns some heat source water to a condenser via a cooling tower from the middle of a circulation line to heat-source water cycle Rhine which piped between the condenser and the evaporator of a refrigerator. And it can be made to correspond also to fluctuation of a space heating load, and the load effect of a condenser easily by adjusting the rate of the amount of water flow of the heat source water poured to the evaporator of a refrigerator in this case, and the amount of water flow made to shunt toward a bypass line.

[0017] Moreover, when a refrigerator can be operated by making the bleeding steam of a steam turbine into a heat source by considering as a refrigerator and adopting an absorption refrigerator and also you need air conditioning in a summer etc. further, the cold water for air conditioning is obtained through the cold-water supply line linked to an evaporator by separating said heat-source water cycle Rhine from an evaporator, and operating a refrigerator.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The schematic diagram of the exhaust-heat-recovery system of the steam turbine facility by the example of this invention
[Description of Notations]
2 Steam Turbine
4 Condenser
5 Absorption Refrigerator
5a Regenerator
5b Condenser
5c Evaporator
5d Absorber
8 Heat-Source Water Cycle Rhine
9 Cooling Tower
10 Bypass Line
11 Cold-Water Supply Line

[Translation done.]

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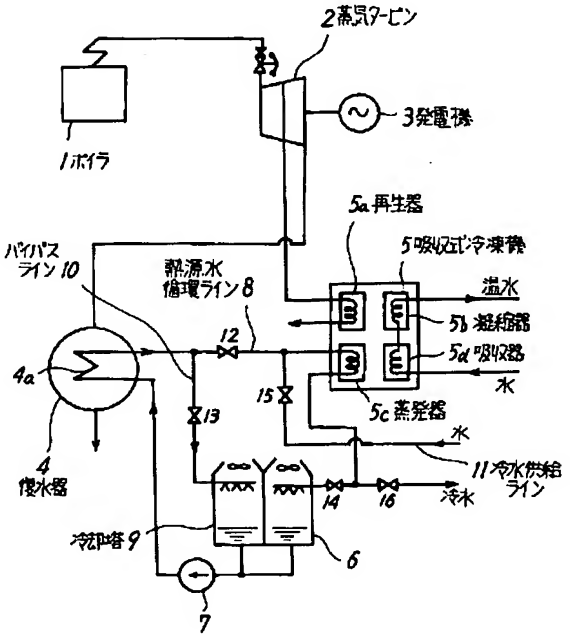
(54)【発明の名称】　蒸気タービン設備の排熱回収システム

(57)【要約】
【目的】蒸気タービン復水器の排熱を利用して暖房用温水を得るとともに、さらに暖房負荷の変動に対応可能な排熱回収システムを得る。
【構成】蒸気タービン２の復水器４から出た冷却排水を熱源水として、復水器と冷凍機５の蒸発器５ｃとの間に配管した熱源水循環ライン８を通じて熱源水を蒸発器５ｃに通水し、該冷凍機をヒートポンプとして運転して凝縮器５ｂより暖房用温水を得るようにするとともに、さらに前記の熱源水循環ライン８に対し、熱源水の一部を循環ライン８の途中から冷却塔９を経由して復水器４に戻すバイパスライン１０を備え、暖房負荷の変動に対応して前記蒸発器５ｃに流す熱源水の通水量とバイパスライン１０へ分流する通水量との割合を調整して運転を行う。



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【特許請求の範囲】

【請求項１】蒸気タービン復水器の排熱を利用して暖房用温水を得る蒸気タービン設備の排熱回収システムであり、表面復水器から出た冷却排水を熱源水として冷凍機の蒸発器に通水し、該冷凍機をヒートポンプとして運転して凝縮器より暖房用温水を得るものにおいて、復水器と冷凍機の蒸発器との間に配管した熱源水循環ラインに対し、熱源水の一部を循環ラインの途中から冷却塔を経由して復水器に戻すバイパスラインを備え、暖房負荷の変動に対応して前記蒸発器に流す熱源水の通水量とバイパスラインへ分流する通水量との割合を調整して運転を行うことを特徴とする蒸気タービン設備の排熱回収システム。

【請求項２】請求項１に記載の排熱回収システムにおいて、冷凍機が、蒸気タービンから抽出した蒸気を再生器に供給して運転する吸収式冷凍機であることを特徴とする蒸気タービン設備の排熱回収システム。

【請求項３】請求項１に記載の排熱回収システムにおいて、冷凍機の蒸発器に対し、復水器との間に配管した熱源水循環ラインの他に冷水供給ラインを接続し、冷房運転時には熱源水循環ラインを蒸発器から切り離した上で、冷水供給ラインを通じて蒸発器より冷房用冷水を得るようにしたことを特徴とする蒸気タービン設備の排熱回収システム。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、汽力発電のコジェネレーションシステムとして適用する蒸気タービン設備の排熱回収システムに関する。

【０００２】

【従来の技術】昨今では、都市のごみ焼却場などを対象とした熱エネルギーの有効利用法として、ごみ焼却炉に付属するボイラにて蒸気を発生させ、この蒸気を使って汽力発電，および地域冷暖房を行うようにしたコジェネレーションシステムが普及化されつつあり、その一例として、発電機を駆動する蒸気タービンから抽出した蒸気を熱源として吸収式冷凍機を運転し、冷房用冷水を得るコジェネレーションシステムが知られている。

【０００３】一方、冷凍機は冷凍運転の他に、蒸発器から熱を取り込み、凝縮器側から暖房用温水を得るようにしたヒートポンプ運転が可能であることから、特に前記した蒸気タービン設備を対象に、蒸気タービンの復水器から出た高温の冷却排水を熱源水として冷凍機の蒸発器に通水し、凝縮器側から暖房用温水を得るとともに、同時に蒸発器を通流して温度の低下した水を冷却水として再び復水器に戻すようにしたヒートポンプによる排熱回収システムが提唱され、その開発が進められている。

【０００４】

【発明が解決しようとする課題】ところで、前記のように蒸気タービン復水器の排熱を利用し、冷凍機をヒートポンプ運転して暖房用温水を得るようにした排熱回収システムでは、復水器から冷凍機の蒸発器が取り込む熱量は復水器の負荷、つまり蒸気タービンの運転条件によって決まる。このために、復水器より出た冷却排水の全量をそのまま冷凍機の蒸発器に通流したのでは、地域暖房のように暖房負荷の変動が大きい場合にうまく対応させることができない。

【０００５】本発明は上記の点にかんがみなされたものであり、先記した蒸気タービン設備の排熱回収システムを改良することにより、復水器の負荷，暖房負荷の変動にも十分に対応できるようにした排熱回収システムを提供することを目的とする。

【０００６】

【課題を解決するための手段】上記課題を解決するために、本発明の排熱回収システムにおいては、復水器と冷凍機の蒸発器との間に配管した熱源水の循環ラインに対して、熱源水の一部を循環ラインの途中から冷却塔を経由して復水器に戻すバイパスラインを備え、暖房負荷の変動に対応して前記蒸発器に流す熱源水の通水量とバイパスラインへ分流する通水量との割合を調整して運転を行うよう構成するものとする。

【０００７】ここで、前記の構成における冷凍機としては、蒸気タービンから抽出した蒸気を再生器に供給して運転する吸収式冷凍機が採用できる。また、当該排気熱回収システムを利用して夏期に冷凍機より冷房用冷水を得るためには、冷凍機の蒸発器に対し復水器との間に配管した熱源水循環ラインの他に冷水供給ラインを接続し、熱源水循環ラインを蒸発器から切り離した上で冷水供給ラインを通じて蒸発器より冷房用冷水を得ることもできる。

【０００８】

【作用】上記の構成において、冷却塔は熱源水循環ラインの途中からバイパスラインに分流する復水器の冷却排水を冷却して温度を下げ、循環ポンプを経て再び復水器に戻すように働く。そして、ヒートポンプ運転時に暖房負荷が変動した場合には、復水器から熱源水として冷凍機の蒸発器へ供給する冷却排水の通水量と、前記バイパスラインへ分流させる通水量との割合を調整することにより、冷凍機の蒸発器に取り込む熱量を暖房負荷の変動に対応させて適正に調整できる。

【０００９】また、冷凍機として吸収式冷凍機を採用することにより、圧縮機を使わずに蒸気タービンから抽出した蒸気を利用して冷凍機を運転できる。さらに、熱源水循環ラインを蒸発器より切り離した状態で冷凍機を冷凍運転すれば、蒸発器に接続した冷水供給ラインを通じて冷房用冷水が得られる。

【００１０】

【実施例】図１は本発明実施例の系統図を示すものである。図において、１はごみ焼却場の焼却炉などに設置したボイラ、２はボイラ１の発生蒸気で運転する蒸気タ－

ビン、３は蒸気タービン２に連結した発電機、４は冷却コイル４ａを内蔵した蒸気タービン２の表面式復水器、５は吸収式冷凍機である。ここで、吸収式冷凍機５は、再生器５ａ，凝縮器５ｂ，蒸発器５ｃ，吸収器５ｄを備えており、蒸気タービン２から抽出した蒸気を熱源として再生器５ａに供給して運転される。なお、かかる吸収式冷凍機の冷凍サイクルについては周知であり、ここではその説明を省略する。

【００１１】一方、復水器４の冷却コイル４ａと前記冷凍機の蒸発器５ｃとの間には、冷却コイル４ａより蒸発器５ｃ，冷却塔６，循環ポンプ７を経由して再び冷却コイル４ａに戻る熱源水循環ライン８が配管されており、冷凍機５をヒートポンプとして運転する場合に、復水器４の冷却コイル４ａから出た高温の冷却排水を熱源水として冷凍機５の蒸発器５ｃに通水し、吸収器５ｄ，凝縮器５ｂを通じて暖房用温水を得るようにしている。また、前記の熱源水循環ライン８に対しては、ラインの途中から分岐して冷却塔９を経由するバイパスライン１０を備えており、さらに蒸発器５ｃには前記した熱源水循環ライン８の他に、冷房用冷水を得る冷水供給ライン１１が接続配管されている。なお、１２～１６は前記ラインの各所に接続した開閉バルブである。

【００１２】かかる構成で冬期に暖房用温水を得る場合には、基本的にはバルブ１２，１４を開，バルブ１３，１５，１６を閉とした状態で、復水器４の冷却コイル４ａより出た高温の冷却排水を熱源水として冷凍機５の蒸発器５ｃに通水し、復水器４で回収した排熱を蒸発器５ｃに与える。これにより冷凍機５はヒートポンプとして作動し、凝縮器５ｂ，吸収器５ｄを通じて暖房用温水が得られる。なお、冷却排水は蒸発器５ｃを通流する過程で熱が奪われるので水温が低下するが、復水器で要求される冷却水温度よりも若干高いので冷却塔６に通して冷却し、再び循環ポンプ７を経て復水器４の冷却コイル４ａに還流する。

【００１３】ここで、暖房負荷が小さい時には、バイパスライン１０に接続したバルブ１３を開き、かつその弁開度を調節して冷却排水の一部を循環ライン８の途中からバイパスライン１０に分流させる。これにより冷凍機５の蒸発器５ｃを通流する熱源水の水量、したがって蒸発器５ｃが取り込む熱量がその時点の暖房負荷に対応するようになる。なお、バイパスライン１０に分流した冷却排水は冷却塔９で冷却された後、蒸発器５ｃ，冷却塔６を経由した水と合流して再び復水器側に戻る。このように蒸発器５ｃに流す熱源水の通水量とバイパスライン１０に分流させる通水量との割合を調整することにより、暖房負荷の変動，ないし復水器の負荷変動に対応させてヒートポンプの熱出力を調整することができる。

【００１４】一方、夏期に冷房用冷水を得る場合には、バルブ１２，１４を閉じて熱源水循環ライン８を蒸発器５ｃより切り離すとともに、バルブ１５，１６を開いて蒸発器５ｃに接続した冷水供給ライン１１に冷却水を流し、この状態で冷凍機５を運転する。これにより、冷水供給ライン１１に流れる水が蒸発器５ｃで冷却されて冷房用冷水が得られる。

【００１５】なお、図示実施例では冷凍機として吸収式冷凍機を採用した例を述べたが、吸収式冷凍機の代わりに圧縮式冷凍機を採用しても同様に実施できる。

【００１６】

【発明の効果】以上述べたように、本発明による蒸気タービン設備の排熱回収システムによれば、復水器と冷凍機の蒸発器との間に配管した熱源水循環ラインに対し、熱源水の一部を循環ラインの途中から冷却塔を経由して復水器に戻すバイパスラインを備えたことにより、冷凍機をヒートポンプとして運転することで、復水器から回収した排熱を利用して地域暖房に必要な暖房用温水が得られる。しかも、この場合に冷凍機の蒸発器に流す熱源水の通水量とバイパスラインに分流させる通水量との割合を調整することにより、暖房負荷の変動，復水器の負荷変動にも容易に対応させることができる。

【００１７】また、冷凍機とし吸収式冷凍機を採用することで、蒸気タービンの抽気蒸気を熱源として冷凍機を運転できる他、さらに夏期などで冷房を必要とする場合には、前記熱源水循環ラインを蒸発器から切り離して冷凍機を運転することにより、蒸発器に接続した冷水供給ラインを通じて冷房用冷水が得られる。

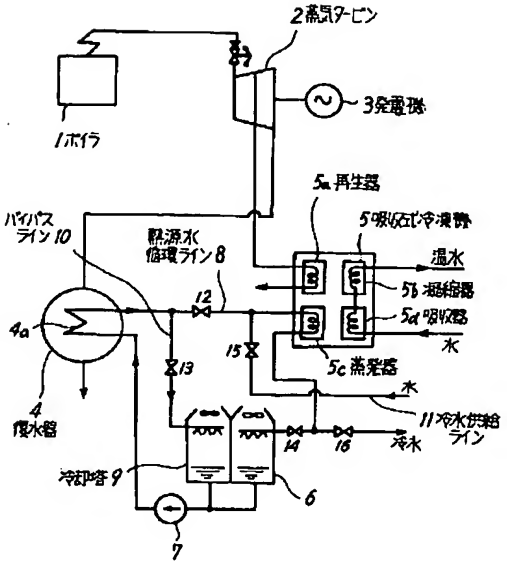
【図面の簡単な説明】

【図１】本発明の実施例による蒸気タービン設備の排熱回収システムの系統図

【符号の説明】

２　蒸気タービン
４　復水器
５　吸収式冷凍機
５ａ　再生器
５ｂ　凝縮器
５ｃ　蒸発器
５ｄ　吸収器
８　熱源水循環ライン
９　冷却塔
１０　バイパスライン
１１　冷水供給ライン

【図１】


2蒸気タービン
3発電機
1ボイラ
5a再生器
5吸収式冷凍機
バイパスライン10
駆動水循環ライン8
温水
5b凝縮器
5d吸収器
水
12
4a
15
13
5c蒸発器
水
4廃水器
11冷水供給ライン
14
16
冷水
冷却塔9
6
7